RATIONAL NUMBERS

YEAR 8 EXTENSION MATHEMATICS

NAME:______________________________

CAPACITY MATRIX – YR 8 EXTENSIONS OF MATHEMATICS

TOPIC: RATIONAL NUMBERS

CONTENT	CAPACITY BREAKDOWN!	DONE IT!!!!	GOT IT!!!!!	ON MY WAY!	WORKING ON IT!	HELP!!!!
1. Index form terminology and expressing numbers as powers of positive integers.	W/S 1 Galaxies, Planets and Star Ships					
2. Squares and square roots	Text Ex 1D Finding square roots using prime factors – W/S 2					
3. Index laws – multiplication and division	W/S 3 Power patterns					
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WORKSHEET ONE – RATIONAL NUMBERS

INDEX NOTATION:

1 Write in index notation:

a $8 \times 8 \times 8$ b $2 \times 2 \times 2 \times 2$ c 17×17
d $6 \times 6 \times 6 \times 6 \times 6$ e $15 \times 15 \times 15 \times 15$ f $T \times T \times T$
g $k \times k \times k \times k \times k$ h $y \times y \times y \times y \times y \times y$ i $x \times y \times y \times y$
j $4 \times p \times p$ k $w \times 5 \times w \times w$ l $a \times b \times a \times b$
m $2 \times y \times y \times y \times 3$ n $3 \times m \times n \times 3 \times m$ o $(pt) \times (pt)$

2 Write in expanded form:

a 17^5 b 23^3 c 18^6 d t^5 e m^4 f c^7
g $3a^2$ h t^2v i $2mn^2$ j $25c^3d^2$ k $4w^2t^2$ l ab^2d

3 Which expressions are the same?

m^2n $\quad mn^2$ $\quad (mn)^2$ $\quad m^2n^2$

Explain your answer.

4 List all the pairs of terms that could be multiplied to give $2xy^2$.

5 Evaluate (correct to 2 decimal places if necessary):

a 15^2 b 15^3 c 10^6 d $(1.3)^2$
e $(1.01)^3$ f 2^7 g 8^5 h 24^3
i $\sqrt{361}$ j $\sqrt{2209}$ k $\sqrt{289}$ l $\sqrt{64}$
m $\sqrt[3]{64}$ n $\sqrt[3]{512}$ o $\sqrt[3]{0.729}$ p $\sqrt{22}$
q $\sqrt{67}$ r $\sqrt[3]{25}$ s $\sqrt[3]{240}$ t $\sqrt[3]{4.096}$

6 Evaluate:

a 6 cubed b 2 to the power of 6
c 19 squared d 2 to the power of 16
e the product of 6 squared and 2 cubed f 10 cubed minus 9 cubed

7 What is the sum of 16 squared and 15 squared?

8 Express 132 651 as a number to the power of 3.

9 Explain why $\sqrt{90}$ lies between 9 and 10.

10 Explain why $\sqrt[3]{90}$ lies between 4 and 5.

11 a The product of 7, 11 and 13 is 1001. Check this on your calculator.

b Calculate:

i 1001×2 ii 1001×3 iii 1001×4
iv 1001×5 v 1001×11 vi 1001×45

Comment on your answers.

c Calculate $(1001)^2$ and $(1001)^3$. Comment on your answers.

12 Evaluate:

a $5^3 \times 7^2$ b $10^4 \div 5^3$ c $(5 \times 8)^2$ d $5^2 \times 8^2$
e 6×9^3 f $(6 \times 9)^3$ g $2^{10} \div 8^2 \div 2^4$ h $\dfrac{3^4}{6^2}$
i $(\sqrt{5})^2$ j $(\sqrt[3]{7})^3$ k $15^2 \times \sqrt{169}$ l $(\sqrt[3]{1331})^2$

13 Show that $(3 \times 4)^2 = 3^2 \times 4^2$.

14 Show that $(6 \times 10)^3 = 6^3 \times 10^3$.

15 Show that $(2 \times 3 \times 4)^2 = 2^2 \times 3^2 \times 4^2$.

16 Show that $(a \times b)^2 = a^2 \times b^2$.

Activity A:
Materials required: Calculator

Galaxies, Planets and Star Ships

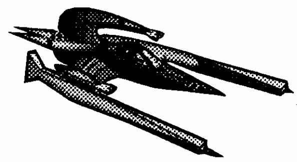
Task 1: In the Xenos galaxy there are five solar systems.
Each solar system has five planets.
Each planet has five moons.

How many moons are in the galaxy?

What calculation did you use to find this answer?

(Check your answer before continuing: There are 125 moons (decimal form), calculated as $5 \times 5 \times 5$ (factor form) or 5^3 (**index** form).)

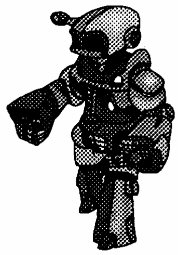
Task 2: The Xenon Star Command has eight Star Ships.
Each Star Ship has eight Star Cruisers.
Each Star Cruiser has eight Star Fighters.
Each Star Fighter has eight crew.



How many crew in the Star Command?
(Write your answer in three ways.)

Factor Form **Index** Form Decimal Form

Task 3: The Xenon army is controlled by ten Generals.
Each General commands ten Majors.
Each Major commands ten Captains.
Each Captain commands ten Sergeants.
Each Sergeant commands ten Corporals.
Each Corporal commands ten Robots.

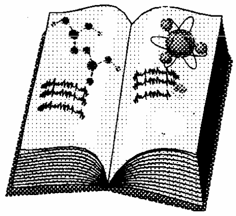


How many Robots are in the army?
Write your answer in three ways:

Factor Form **Index** Form Decimal Form

Look at these other situations which can use **index** form.
Give your answer to each in the 3 ways illustrated above.

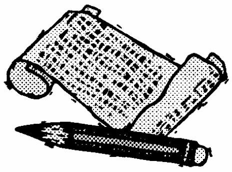
Task 4: A science book has 7 sections each with 7 chapters. Each chapter has 7 exercises each with 7 questions of 7 parts.



How many parts are in the book?

Task 5: Karrie sends a chain letter to six of her friends. They each send it to six of their friends and so it continues.

How many letters are sent on the:



Second round?

Third round?

Complete this table.

Number of Rounds	1	2	3	4	5	6	7
Letters Sent	6	36					
Power of 6	6^1	6^2					

How many letters will be sent on the tenth round?

WORKSHEET 2 – FINDING SQUARE ROOTS WITHOUT THE CALCULATOR

1 Evaluate each of the following:

a $7^2 - 3^3$ **b** 8×4^2 **c** $5^3 \times 2^2$

d $3^3 + 6^2 - 4^2$ **e** $3^4 + 3^3 + 3^2 + 3$ **f** $1^2 + 2^2 + 3^2 + 4^2$

2 Arrange each of these sets of index terms in order, from the smallest value to the largest.

a $2^3, 3^2, 3^5, 5^3, 2^5, 5^2$ **b** $4^4, 7^3, 3^5, 8^2, 5^2, 6^3$ **c** $100^2, 1^{14}, 2^7, 3^4, 5^4$

3 a Copy and complete:

$1^2 =$

$11^2 =$

$111^2 =$

$1111^2 =$

b Based on the patterns in your answers to part **a**, write the squares of these numbers:

i 11 111 **ii** 1 111 111 **iii** 111 111 111 **iv** 1 111.1111

4 a Copy and complete this number pattern:

$$\begin{aligned} 1 &= 1 \\ 2+3+4 &= \_\_\_ + \_\_\_ &&= (1)^3 + (2)^3 \\ 5+6+7+8+9 &= 8 + 27 &&= (\_\_\_)^3 + (\_\_\_)^3 \\ 10+11+12+13+14+15+16 &= \_\_\_ + \_\_\_ &&= (\_\_\_)^3 + (\_\_\_)^3 \end{aligned}$$

b Write the next two lines of the pattern in part **a**.

c Find the sum without adding each time. Show how you did it.

i $50 + 51 + \ldots + 63 + 64$ **ii** $82 + 83 + \ldots + 99 + 100$

iii $290 + 291 + \ldots + 323 + 324$ **iv** $577 + 578 + \ldots + 624 + 625$

5 Try finding the square root of each of these numbers. (They're not as hard as they look!)

a 2500 **b** 8100 **c** 10 000

d 1 000 000 **e** 1 210 000 **f** 100 000 000

g 640 000 **h** 176 400 **i** 10 000 000 000

6 Find the cube root of each of these numbers. (What you discovered in Question **5** should help.)

a 8000 **b** 343 000 **c** 1 000 000

d 64 000 000 **e** 1 000 000 000 **f** 27 000

7 Find the square root of:

a $3 \times 3 \times 2 \times 2$ **b** $5 \times 5 \times 4 \times 4 \times 3 \times 3$

c 36×49 **d** $16 \times 25 \times 4$

8 Find the cube root of:

a $2 \times 2 \times 2$ **b** $4 \times 4 \times 4 \times 5 \times 5 \times 5$

c $7 \times 7 \times 7 \times 6 \times 6 \times 6$ **d** 8×27

e $125 \times 64 \times 1000$ **f** 343×729

9 Find the value of:

a $\sqrt{9^2}$ **b** $\sqrt{3^4}$ **c** $\sqrt{5^4 \times 2^6}$ **d** $\sqrt[3]{2^9}$ **e** $\sqrt[3]{3^3 \times 5^6}$ **f** $\sqrt[4]{16}$

10 Two prime numbers that differ by 2 are called **twin primes**. For example, 11 and 13 are twin primes, but 23 and 29 are not. Find the sets of twin primes between 1 and 100.

WORKSHEET 3 – INDEX LAWS

Multiplication and Division

1 Simplify these products, leaving each answer in index form:

a $4^2 \times 4^3$ **b** $2^3 \times 2^5$ **c** $6^4 \times 6^3$ **d** 2×2^6
e $5^4 \times 5$ **f** 3×3^8 **g** $4^3 \times 4^3$ **h** $9^4 \times 9^6$
i $10^2 \times 10^4$ **j** $8^5 \times 8 \times 8$ **k** $10^9 \times 10 \times 10^2$ **l** $5^3 \times 5 \times 5^4 \times 5^2$

4 Simplify, leaving each answer in index form:

a $2^5 \div 2^3$ **b** $7^5 \div 7^3$ **c** $\frac{10^6}{10^2}$ **d** $9^8 \div 9^6$
e $5^6 \div 5^5$ **f** $\frac{8^{10}}{8^9}$ **g** $2^{12} \div 2^4$ **h** $3^7 \div 3$
i $\frac{4^5}{4^4}$ **j** $7^{15} \div 7^{10}$ **k** $12^{12} \div 12$ **l** $\frac{18^{20}}{18^{10}}$

6 Evaluate:

a $5^8 \div 5^6$ **b** $10^7 \div 10^5$ **c** $2^3 \times 2^2$ **d** $3^{10} \div 3^7$
e $8^7 \div 8^4$ **f** $2^4 \times (2^3)^2$ **g** $(7^4)^2 \div 7^6$ **h** $(4^2)^3 \div 4^5$
i $(2^2 \times 3)^2$ **j** $8^5 \div 8^2 \div 8$ **k** $3^6 \div 3^5 \times 3^3$ **l** $(2^6)^2 \div 4^5$
m $2^7 \times 2^5 \div 2^8$ **n** $6^3 \times 6^2 \div 6^5$ **o** $(10^5)^2 \div 10^{10}$ **p** $2^{20} \div 4^{10}$

WORKSHEET 4 – Zero and Negative index

[redacted] Simplify, giving the answer as a fraction:

a 5^{-1} b 7^{-1} c 10^{-1} d 4^{-1}
e x^{-1} f k^{-1} g 4^{-2} h 3^{-2}
i 3^{-3} j 5^{-3} k 2^{-5} l 6^{-3}
m m^{-3} n $(t^{-2})^2$ o $(x^{-1})^3$ p $(m^4)^{-2}$

[redacted] Rewrite, showing the variable with a negative index:

a $\frac{1}{a}$ b $\frac{1}{m}$ c $\frac{1}{e}$ d $\frac{1}{x}$
e $\frac{1}{m^2}$ f $\frac{1}{y^3}$ g $\frac{1}{c^4}$ h $\frac{1}{w^5}$

[redacted] Simplify, giving the answer as a fraction when appropriate:

a $10^6 \div 10^6$ b $8^5 \div 8^5$ c $x^8 \div x^8$ d $n^{10} \div n^{10}$
e $4^3 \div 4^6$ f $2^5 \div 2^7$ g $3^6 \div 3^9$ h $5^3 \div 5^4$
i $k^3 \div k^5$ j $p^6 \div p^7$ k $b \div b^3$ l $5k \div 5k$
m $6b^5 \div b^5$ n $12c^3 \div 4c^3$ o $10m^4 \div 10m^5$ p $32t^3 \div 8t^4$

SECTION TWO

[redacted] Evaluate:

a 8^0 b 7^0 c 3^0 d $(5)^0$
e c^0 f r^0 g $(ab)^0$ h 227^0
i $5t^0$ j $9z^0$ k $33v^0$ l $(xy)^0$
m $8r^0 + 1$ n $7s^0 - 2$ o $15k^0 + 3f^0$ p $(15k + 3f)^0$

[redacted] Simplify, giving the answer as a fraction:

a 5^{-1} b 7^{-1} c 10^{-1} d 4^{-1}
e x^{-1} f k^{-1} g 4^{-2} h 3^{-2}
i 3^{-3} j 5^{-3} k 2^{-5} l 6^{-3}
m m^{-3} n $(t^{-2})^2$ o $(x^{-1})^3$ p $(m^4)^{-2}$

[redacted] Rewrite, showing the variable with a negative index:

a $\frac{1}{a}$ b $\frac{1}{m}$ c $\frac{1}{e}$ d $\frac{1}{x}$
e $\frac{1}{m^2}$ f $\frac{1}{y^3}$ g $\frac{1}{c^4}$ h $\frac{1}{w^5}$

[redacted] Simplify, giving the answer as a fraction when appropriate:

a $10^6 \div 10^6$ b $8^5 \div 8^5$ c $x^8 \div x^8$ d $n^{10} \div n^{10}$
e $4^3 \div 4^6$ f $2^5 \div 2^7$ g $3^6 \div 3^9$ h $5^3 \div 5^4$
i $k^3 \div k^5$ j $p^6 \div p^7$ k $b \div b^3$ l $5k \div 5k$
m $6b^5 \div b^5$ n $12c^3 \div 4c^3$ o $10m^4 \div 10m^5$ p $32t^3 \div 8t^4$

WORKSHEET 5 – Fractional Index

SECTION ONE

Evaluate:

a $36^{\frac{1}{2}}$	**b** $16^{\frac{1}{2}}$	**c** $81^{\frac{1}{2}}$	**d** $100^{\frac{1}{2}}$	**e** $9^{\frac{1}{2}}$
f $1^{\frac{1}{2}}$	**g** $144^{\frac{1}{2}}$	**h** $289^{\frac{1}{2}}$	**i** $8^{\frac{1}{3}}$	**j** $125^{\frac{1}{3}}$
k $64^{\frac{1}{3}}$	**l** $64^{\frac{1}{2}}$	**m** $343^{\frac{1}{3}}$	**n** $1000^{\frac{1}{3}}$	**o** $4900^{\frac{1}{2}}$
p $8000^{\frac{1}{3}}$	**q** $625^{\frac{1}{2}}$	**r** $125\,000^{\frac{1}{3}}$	**s** $729^{\frac{1}{2}}$	**t** $729^{\frac{1}{3}}$

Write in index form:

a $\sqrt{5}$	**b** $\sqrt{8}$	**c** $\sqrt[3]{7}$	**d** $\sqrt[3]{15}$	**e** $\sqrt{x}$
f $\sqrt{a}$	**g** $\sqrt[3]{c}$	**h** $\sqrt[3]{y}$	**i** $\sqrt{3mn}$	**j** $\sqrt[3]{2xy}$

Use index laws to simplify, then evaluate if possible:

a $\sqrt{3^6}$	**b** $\sqrt{5^4}$	**c** $\sqrt{7^6}$	**d** $\sqrt{10^8}$	**e** $\sqrt[3]{5^6}$
f $\sqrt[3]{4^6}$	**g** $\sqrt[3]{2^9}$	**h** $\sqrt[3]{10^{12}}$	**i** $\sqrt{k^8}$	**j** $\sqrt{t^{10}}$
k $\sqrt{x^6}$	**l** $\sqrt[3]{x^6}$	**m** $\sqrt[3]{y^9}$	**n** $\sqrt[3]{c^{18}}$	**o** $\sqrt{c^{18}}$
p $\sqrt{2^4 \times 5^2}$	**q** $\sqrt{2^6 \times 3^4}$	**r** $\sqrt{5^4 \times 7^2}$	**s** $\sqrt[3]{3^6 \times 5^3}$	**t** $\sqrt[3]{2^{12} \times 3^6}$

WORKSHEET 6 – SUMMARY OF INDEX LAWS AND NUMERALS.

1 Simplify each of the following, leaving your answers in index form:

a $2^4 \times 2^7$	**b** $15^9 \times 15^2$	**c** $4^{10} \div 4^7$
d $7^5 \times 7^4 \times 7^3$	**e** $9^8 \div 9^7$	**f** $3^8 \div 3^5 \div 3$
g $(4^3)^2$	**h** $(8^2)^4$	**i** $(7^3)^5 \times 7^4$
j $2^{20} \div (2^3)^4$	**k** $7^{10} \div (7^3)^3$	**l** $(14^5)^3 \div (14^2)^3$

2 Simplify:

a $x^3 \times x^4$	**b** $w^8 \times w^9$	**c** $m^7 \div m^2$
d $k^3 \div k$	**e** $(m^2)^4$	**f** $(y^4)^6$
g $a^3 \times a^7 \div a^8$	**h** $(p^2)^3 \div p^5$	**i** $t^7 \times (t^2)^3$
j $(d^4)^4 \div d^{12}$	**k** $q^6 \div q^4 \times q^5$	**l** $2b^2 \times 3b^5$
m $4d^7 \times 5d^6$	**n** $30c^{12} \div 5c^8$	**o** $24e^8 \div 6e^5 \times 2e^3$

3 Evaluate each of the following:

a 3^0	**b** $16^{\frac{1}{2}}$	**c** 5^0	**d** 7×2^0
e $27^{\frac{1}{3}} + 0$	**f** $5^0 + 10^0$	**g** $(7^2)^0$	**h** $8^{\frac{1}{3}} + 4^{\frac{1}{2}}$

4 Simplify each of the following:

a $(3m^5)^2$	**b** $a^2w^2 \times a^3w^7$	**c** $x^3y \times x^2y^4$
d $p^3q^5 \times pq^6$	**e** $m^5n^2 \times m^2n^3$	**f** $2c^2d^5 \times 3c^3d^3$
g $4w^5m \times 5w^3m^4$	**h** $2 \times 3ab^3 \times 4a^2b^3$	**i** $(2y^3)^4 \times 3y^5$
j $4v^2 \div 2v$	**k** $m^7n^3 \div m^5n^2$	**l** $a^{13}c^6 \div a^5b^2$
m $24l^5d^3 \div 6l^2d$	**n** $\dfrac{15x^5y^7}{5x^2y^4}$	**o** $36g^3h^4 \div 9g^2h^2 \times 2gh^4$

5 Evaluate:

a $7^4 \div 7^3$	**b** $8^5 \div 8^2 \div 8$	**c** $4^3 \times 4^7 \div 4^8$
d $24^3 \div 24^3$	**e** $5^2 \div 5^0$	**f** $3^3 + 2^2$
g $(3^3)^2 \div 3^5$	**h** $8^7 \times 8^4 \div 8^{11}$	**i** $(-2)^3$
j $(-2)^2$	**k** $(-5)^0 + (-2)^0$	**l** $3 + 3^0$

6 Express each of these with a fractional index:

a $\sqrt{5}$	**b** $\sqrt{d}$	**c** $\sqrt{3y}$	**d** $\sqrt[3]{10}$
e $\sqrt[3]{4p}$	**f** $\sqrt{xy}$	**g** $\sqrt[3]{1000}$	**h** $\sqrt[3]{3m^2n}$

7 Express each of these using positive indices:

a 7^{-8}	**b** 2^{-10}	**c** 15^{-1}	**d** y^{-3}
e $(5x)^{-1}$	**f** 9^{-2}	**g** 10^{-3}	**h** $(ab)^{-1}$
i $4y^{-8}$	**j** $(3a^2)^{-1}$	**k** $10d^{-1}$	**i** p^3q^{-5}
m $6x^{-3}$	**n** mw^{-3}	**o** c^2e^{-3}	**p** $8t^3m^{-4}$

8 Evaluate each of the following, leaving your answer as a fraction each time:

a 2^{-2}	**b** 3^{-1}	**c** 20^{-1}	**d** 5^{-3}
e 8^{-3}	**f** 10^{-4}	**g** 6^{-4}	**h** 3^{-5}

9 Write these fractions using negative indices:

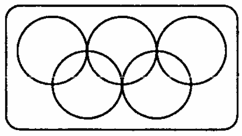
a $\dfrac{1}{4^3}$	**b** $\dfrac{1}{2}$	**c** $\dfrac{1}{10^3}$	**d** $\dfrac{1}{7^4}$
e $\dfrac{1}{w}$	**f** $\dfrac{1}{k^4}$	**g** $\dfrac{1}{d^7}$	**h** $\dfrac{1}{3^3}$

10 Evaluate:

a 2^{-3}	**b** $(64^{\frac{1}{3}})^4$	**c** $(8^2)^{\frac{1}{3}}$	**d** $(9^3)^{\frac{1}{2}}$
e $12^4 \div 12^4$	**f** $(8^0)^2$	**g** $4^{-3} \times 4^3$	**h** $5^8 \div 5^3$
i $m^0 + k^0$	**j** $(5^3)^0$	**k** $3^5 \div 3^7$	**l** $6^3 \div 6^4$

Puzzle A:

Olympic Cities

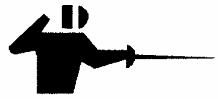


All of the missing cities in this puzzle have hosted the Summer Olympic Games over the last seven decades.

By finding 21 pairs of boxes with equal numbers in them you can break the code to fill in the Olympic cities and their countries.

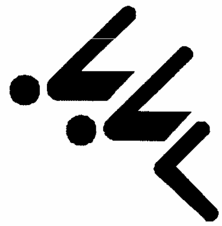
D 2401	2 2^{-3}	M 10^4	4 $(0.5)^5$	L 128	R 4^5
8 10^{-3}	W 243	955	H $\left(\frac{1}{2}\right)^4$	12 3^{-2}	G 4^{-1}
160	T 1	1764	C 3125	18 2^{12}	780
1454	101024	15 $(0.1)^{-3}$	K 0.125	A $\left(\frac{1}{8}\right)^{-2}$	110.063
174	F 1296	200.5	5 2^7	1964	I 4096
635	130.25	P $\frac{1}{32}$	O 2^{-1}	N 625	B 1000
S $\frac{1}{9}$	2185	3 10 000	E 32 768	U 100^{-2}	Y 0.001

1936														
	15	21	10	5	18	14		13	21	10	3	19	14	8



1948														
	5	20	14	1	20	14		21	14	13	5	19	14	1

1952								
	11	21	5	12	18	14	2	18
	17	18	14	5	19	14	1	

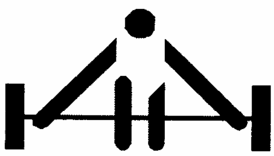


1960										
	10	20	3	21		18	7	19	5	8

1976															
	3	20	14	7	10	21	19	5		9	19	14	19	1	19

1980													
	3	20	12	9	20	6		10	16	12	12	18	19

1992															
	15	19	10	9	21	5	20	14	19		12	4	19	18	14



WORKSHEET 7 – SCIENTIFIC NOTATION

1 Express the numbers in each of the following statements in scientific notation.

- **a** The distance from Earth to the Sun is 152 000 000 kilometres.
- **b** The world's largest mammal is the blue whale, which can have a mass of up to 130 000 kg.
- **c** The diameter of an oxygen molecule is 0.000 000 29 cm.
- **d** The thickness of a human hair is 0.000 08 m.
- **e** Light travels at a speed of 300 000 000 m/s.
- **f** The nearest star to Earth, excluding the Sun, is Alpha Centauri C, which is 40 000 000 000 000 km away.
- **g** The mass of a proton is 0.000 000 000 000 000 000 002 g.
- **h** The thickness of a typical piece of paper is 0.000 12 m.
- **i** The small intestine of an adult is approximately 610 cm long.
- **j** The diameter of one hydrogen atom is 0.000 000 0001 m.
- **k** The diameter of our galaxy, the Milky Way, is 770 000 000 000 000 000 000 m.
- **l** A microsecond measures 0.000 001 s.
- **m** The Andromeda Galaxy is the most remote body visible to the naked eye. It is at a distance of 2 200 000 light years from Earth.

Blue whale

2 Express each of the following numbers in scientific notation:

a 2400	**b** 786 000
d 95	**e** 7.8
g 59 670	**h** 15
j 80	**k** 763
m 456.3	**n** 8.007

3 Express each of these numbers in scientific notation:

a 0.035	**b** 0.000 076
d 0.0713	**e** 0.000 003
g 0.000 007 146	**h** 0.009
j 0.89	**k** 0.000 000 078

4 Express each of these numbers in scientific notation:

a 25 000	**b** 4 400 000
d 7	**e** 0.4
g 0.000 875	**h** 6.7
j 0.000 000 000 9	**k** 73
m 0.552	**n** 2299
p 563.7	**q** 0.0001
s 270 000 000	**t** 400.4

5 Express each of the following in decimal form:

a 5.7×10^3	**b** 5.7×10^2
d 5.7×10^0	**e** 5.7×10^{-1}
g 5.7×10^{-3}	**h** 8×10^2
j 8×10^0	**k** 8×10^{-1}

6 Express each of the following in decimal form:

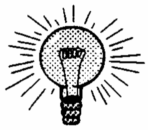
a 6×10^5	**b** 7.1×10^3
d 3.14×10^0	**e** 6×10^{-5}
g 3.02×10^{-8}	**h** 5.9×10^{-10}
j 4×10^{-4}	**k** 5×10^3
m 8.03×10^{-1}	**n** 6.32×10^4
p 2.2×10^{-7}	**q** 9.0×10^6

4 Calculate how often you each blink in the following periods of time. (Write your answers in scientific notation correct to two significant figures.)
- **a** an hour
- **b** a waking day of 16 hours
- **c** a year
- **d** an average lifetime of 75 years

5 If a blink takes approximately 0.5 seconds, calculate how long you will each have your eyes closed in the following periods of time:
- **a** a minute
- **b** an hour
- **c** a waking day
- **d** a waking year
- **e** an average waking lifetime

Project: Massive to Minute

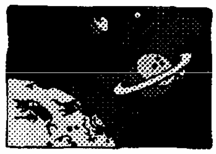
Task 1: The values below are either very large (massive) or very small (minute). Your task is to find out any <u>six</u> of these values and write them using **scientific notation**.



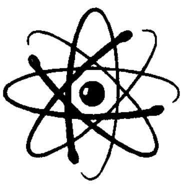
How many metres light travels in a day.

The number of molecules in a litre of water.

How far it is to the Andromeda Galaxy.



The population of the world.



The size of a hydrogen atom.

The number of cells in a human body.

The size of a flu virus.

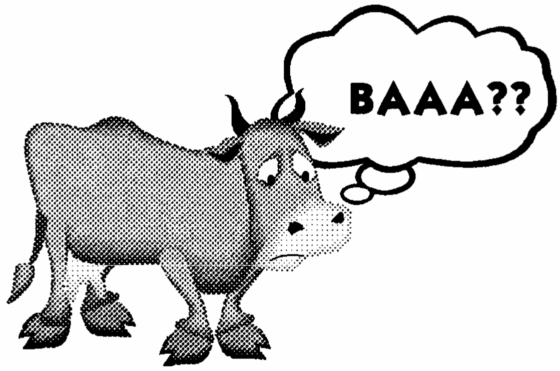
The size of a protozoa.

The distance from the Earth to the Moon.

The distance from the Sun to the star Vega.

Puzzle B:

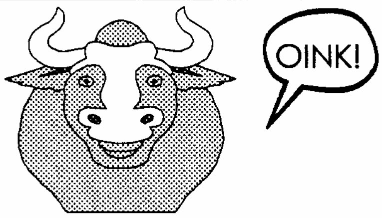
Cow Speak:
Why did the cows keep saying "baa", "oink", and "quack"?



Match each of the following to their correct **scientific notation** to solve this important bovine question.

1	256 000	6	256×10^4	11	670×10^{-4}
2	25.6×10^3	7	840×10^3	12	640×10^{-2}
3	0.0067	8	7 thousandths	13	7 hundredths
4	84 million	9	950 thousand	14	0.64×10^{-1}
5	940×10^4	10	0.07×10^{-2}	15	seven tenths

S	9.5×10^5	N	2.56×10^5	H	7×10^{-3}
Y	8.4×10^7	L	6.7×10^{-2}	G	2.56×10^6
R	7×10^{-4}	O	6.4×10^0	E	7×10^{-1}
A	6.4×10^{-2}	F	2.56×10^4	U	6.7×10^{-3}
W	9.4×10^6	T	8.4×10^5	I	7×10^{-2}



7	8	15	4	5	15	10	15	11	15	14	10	1	13	1	6

2	12	10	15	13	6	1	11	14	1	6	3	14	6	15	9

WORKSHEET 9 – SIGNIFICANT FIGURES

Use the index laws to simplify each of the following. Give your answers in scientific notation.

a $(2 \times 10^3) \times (3 \times 10^5)$ **b** $(8 \times 10^7) \div (4 \times 10^2)$

c $(2 \times 10^5)^3$ **d** $\sqrt{9 \times 10^{12}}$

e $(4 \times 10^7) \times (6 \times 10^8)$ **f** $(1 \times 10^8) \div (2 \times 10^3)$

g $(4 \times 10^3)^5$ **h** $(9 \times 10^5) \times (8 \times 10^3) \div (4 \times 10^2)$

i $(2 \times 10^{-3})^2$ **j** $(9 \times 10^{-4}) \div (3 \times 10^8)$

k $(5 \times 10^8) \times (2 \times 10^2)^3$ **l** $(4.2 \times 10^5) \div (6 \times 10^{-5})$

Find the answers to the following in scientific notation:

a $(8.4 \times 10^7) \times (3.4 \times 10^8)$ **b** $(9.4 \times 10^{12}) + (8.3 \times 10^{15})$

c $(4.9 \times 10^{-6}) - (3.7 \times 10^{-7})$ **d** $(1.575 \times 10^{-3}) \div (5 \times 10^7)$

e $24.08 \div (8 \times 10^6)$ **f** $\sqrt{3.969 \times 10^{19}}$

g $(3.2 \times 10^9)^2$ **h** $\sqrt[3]{8 \times 10^{-9}}$

i $\dfrac{7.62 \times 10^9}{2 \times 10^{-4}}$ **j** $(7.6 \times 10^3) \times (4.5 \times 10^5) \div (3 \times 10^{-8})$

Evaluate, giving your answers in scientific notation, correct to three significant figures:

a $(5.12 \times 10^5) \times (8.3 \times 10^7)$ **b** $(2.03 \times 10^{35}) + (1.23 \times 10^{34})$

c $(7.4 \times 10^{30}) - (3.59 \times 10^{29})$ **d** $(1.076 \times 10^{17}) \div (2.3 \times 10^{11})$

e $\sqrt{6.6 \times 10^{27}}$ **f** $(7.5 \times 10^{23}) \div (3.3 \times 10^{-13})$

g $(8.17 \times 10^{16})^3$ **h** $\sqrt[3]{2.69 \times 10^{26}}$

i $(7.05 \times 10^3) \div (3.9 \times 10^7)$ **j** $\dfrac{(5.6 \times 10^4) \times (3.9 \times 10^5)}{(2.3 \times 10^7)}$

Estimate each of the following, leaving your answers in scientific notation:

a $(5.7 \times 10^3) \times (2.3 \times 10^5)$ **b** $(8.4 \times 10^5) \times (3.7 \times 10^7)$

c $(9.1 \times 10^{20}) \div (3.2 \times 10^5)$ **d** $(1.6 \times 10^8)^2$

e $(7.13 \times 10^{10}) \times (9.8 \times 10^8)$ **f** $(1.99 \times 10^{11}) \div (2.01 \times 10^7)$

g $(5.85 \times 10^4) \div (2.05 \times 10^8)$ **h** $(6.3 \times 10^{12}) \div (2.9 \times 10^3)$

Manal's answer for $(8.3 \times 10^{15}) \times (5.125 \times 10^{17})$ was 4.25×10^{34}, correct to three significant figures.

a Estimate an answer to the calculation.
b Is Manal's answer correct? Give reasons.

6 Simplify, giving your answers in scientific notation correct to two significant figures:

a 595×959 **b** $1000 \div 3$ **c** 2^{20} **d** $6 \div 11$

e 81^{-1} **f** 3^{-10} **g** 9^9 **h** $(0.75)^{-5}$

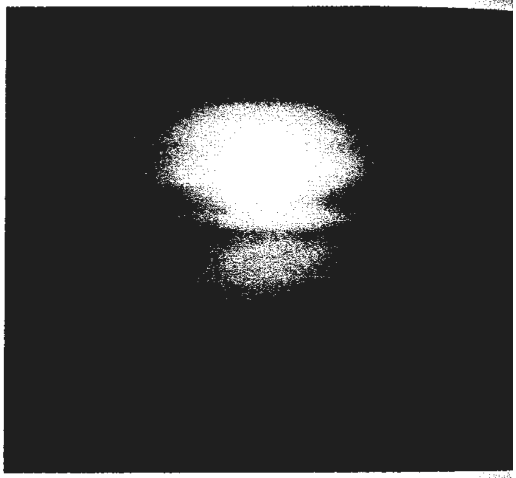
7 a The human body consists of approximately 6×10^9 cells and each cell consists of 6.3×10^9 atoms. Roughly how many atoms are in a human body? (Express your answer in scientific notation.)

b Earth is 1.52×10^8 km from the Sun and the speed of light is 3×10^5 km/s. How long does it take for light to travel from the Sun to Earth? Express your answer in:

i seconds **ii** minutes

8 Answer the following in scientific notation, correct to two significant figures where necessary.

a A telephone directory is 4.5 cm thick. There are 2000 pages in it. Find the thickness, in millimetres, of one page.



b The Sun burns 6 million tonnes of hydrogen a second. Calculate how many tonnes of hydrogen it burns in a year (that is $365\frac{1}{4}$ days).

c Sound travels at approximately 330 metres per second. If MACH 1 is the speed of sound, how fast is MACH 5? Convert your answer to kilometres per second.

d The distance light travels in one year is called a light year. If the speed of light is approximately 3×10^5 km per second, how far does light travel in one year?

e The nearest star (*Alpha Centauri*) is 4.3 light years away from Earth. How long would it take a spaceship travelling from Earth at the speed of light to reach the star?

f In a science-fiction space movie, WARP 1 is the speed of light. If a spaceship travels at WARP 9, which is nine times the speed of light, how fast is this in metres per second?

g A thunderstorm is occurring 33 km from where you are standing. Use the speed of light (3×10^5 km per second) and the speed of sound (330 metres per second) to calculate:

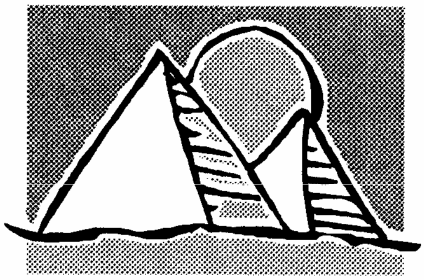
i how long the light from the lightning takes to reach you

ii how long the sound from the thunder takes to reach you.

9 a What is the largest number that can be displayed on your calculator?

b What is the smallest number that can be displayed?

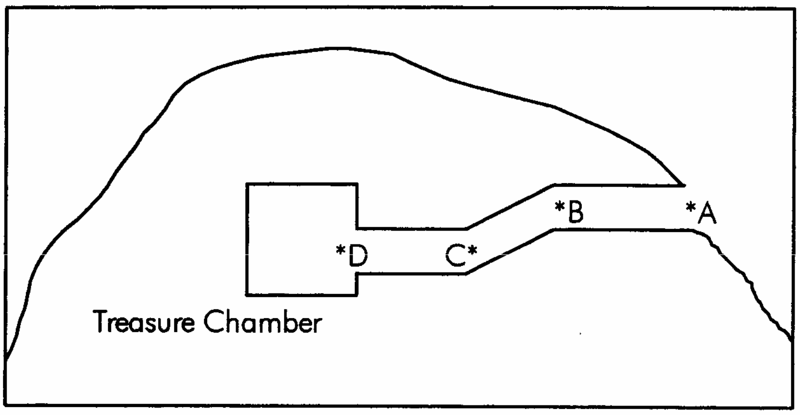
Application C:
Materials required: Calculator



Mirrors and Light

The interior of the Great Pyramids of Giza in Egypt are decorated with intricate art work that may have been done without the use of any type of lamps.

One theory is that sunlight was reflected into the interior by the means of a system of mirrors to light the area the artists were working in. The problem they had was that the light lost some of its intensity as it was reflected by a series of mirrors.



The diagram here shows a chamber in a hillside and the position of four mirror holders A to D.

Task 1: Why are mirrors positioned at each of these positions?

Task 2: How many reflections of light are necessary to get the natural sunlight to the artists of the chamber?

Task 3: With the mirrors first made for this purpose, the light intensity reflected from each mirror was 30% of the intensity that struck the mirror. This means that mirror B would only receive 30% of the sunlight from mirror A, mirror C would receive only 30% of the sunlight from mirror B and so on.

$B = 0.3 \times S$ (Where S represents the intensity of sunlight.)

$C = 0.3 \times 0.3 \times S = 0.3^2 \times S = 0.09 \times S$

Complete the sunlight intensity for mirror D :

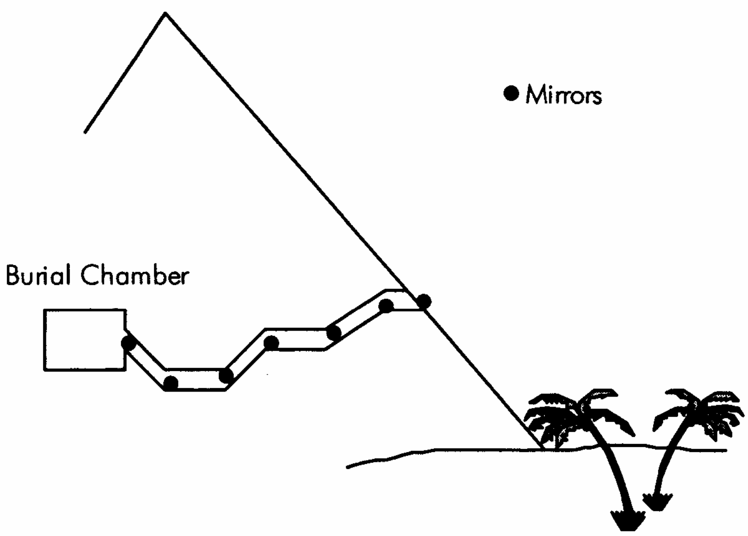
$D =$

Task 4: What would be the sunlight intensity that reaches the artists?

Task 5: If artists need $0.005 \times S$ to work, are they able to work in the chamber?

Task 6: Later, better mirrors were invented with a reflective **power** of 40%. What sunlight intensity would now reach the artists?

Task 7: Find the sunlight intensity reaching the artists working in the burial chamber of this pyramid using the each of the reflecting mirrors above.



Task 8: Find the sunlight intensity for artists working with these conditions.

Number of mirrors	Reflective power	Calculation	Sunlight intensity	Suitable for artist working?
6	40%			
6	50%			
5	30%			
5	40%			

Task 9: Design your own Treasure Chamber that requires at least 6 mirrors and use one of the reflective **powers** above to see if your artists would be able to work in the chamber.